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on the paramecia and rotifers, for at the end of ten minutes locomotion was evident in these, although not so rapid as in the clear water.

During swimming these ciliata have a spiral motion which is to the right. Trichocysts were noted in the larger specimens, this being limited to the posterior region. Some of them seemed to possess contractile vacuoles while others did not. The anterior end is hook-like but not a rostrum. In this respect it differs from *Loxodes rostrum* (Mull.); the anterior end is also more blunt, and the dorsal surface was more curved than in *L. rostrum*.

Further study upon this species and the genus is in progress.

Chadwick, N. Y.

ELTON R. DARLING.

ENTOMOLOGICAL NOTES

Variation in Spermatozoa.—Zeleny and Senay ('15, Journ. Exp. Zool., 19:505-514) report results of studies on variation in head length of spermatozoa in insects. This work is a continuation of earlier studies by Zeleny and Faust, an abstract of which appears in this journal (34:191). The following insects were studied: *Corizus lateralis*, *Leptocoris trivittatus*, *Reduviolus ferus*, *Euschistus variolarius*, *Cosmopepla carnifex*, *Passalus cornutus*, and *Berosus striatus*. With the exception of *Passalus cornutus*, all gave distinctly bimodal curves indicating the existence of two distinct size groups of spermatozoa. The one exception yielded a unimodal curve and is interpreted as indicating lack of distinction among the spermatozoa or else as having two groups which differ so slightly from each other that a unimodal result is produced. Additional support is thus given to the belief that dimorphism in size of spermatozoa is common among animals having two chromosomal classes of spermatids, due to quantitative differences in chromosomal content.

Bibliographies.—The Journal of Animal Behavior (5:407-461) has issued its annual lists of literature pertaining to the behavior of animals. Turner (pp. 415-445) has given a brief analysis of the more important results which have appeared in the literature of 1914 and lists one hundred seven papers from American and foreign sources which treat of the behavior of spiders and insects other

than ants. The analysis of subject matter is very useful and the list of titles, while not entirely complete, forms an important source of information.

Differential Incidence of Bruchus.—Harris ('15, Journ. N. Y. Ent. Soc., 23:242-253) reports the results of a statistical study on "differential incidence of the beetle *Bruchus*" in which the purpose was to discover whether the characters of the bean pod, on which the eggs of *Bruchus* are laid, determine, to any degree, the frequency of infestation ("parasitization"). Examination of over fourteen thousand pods, producing almost forty thousand seeds, showed that the relative number of infested seeds is greater in pods with larger numbers of ovules. Increase in percentage of infestation accompanies increase in the number of seeds matured per pod. No relationship between the position of the seed in the pod and liability of infestation was discovered. The hypothesis offered is that since young pod size is correlated with the number of ovules and the number of developing seeds, thus resulting, in the larger pods, increased ease of foothold and additional facility for oviposition are made possible.

Respiration in Zygoterous Larvæ.—Calvert ('15, Ent. News, 26:435-447) summarizes the literature on the subject of the respiration of zygoterous larvæ (Odonata). From compiled and original data it appears that the oxygen demands of the animals are satisfied, at least in part, by several modes of respiration. The general body-surface, the caudal processes, the rectal epithelium, certain spiracles, and, in some species, the lateral external tracheal gills, all form functional parts of the respiratory system.

Behavior of the Ant-lion.—Turner ('15, Biol. Bull., 29:277-307) has studied the behavior of the ant-lion and finds, among numerous other things, that the characteristic pits, which may be found in any kind of dry friable soil in protected situations, are constructed either by furrowing backward, producing a series of concentric excavations, each deeper than the preceding and removing the soil with the head, or by the simple removal of the soil until the sides of the pit become somewhat stable. Locomotion is invariably backward, never forward. "Any invertebrate, be it insect, arachnid, or crustacean, that happens to fall into the trap is accept-

able as food." Letisimulation (death-feigning) often follows rough handling or other similar treatment and, though variable in duration, mutilation may frequently fail to produce response. No well-defined relation appears to exist between the duration of the feint and temperature, fasting, or strength of the stimulus.

Reaction of Epeira.—Barrows ('15, Biol. Bull., 19:316-326) finds that the large orb weaving spider, *Epeira scolopetaria*, orients itself, when going from the center of the web to capture entangled flies, in response to a vibratory stimulus. The stimulus can be submitted experimentally and produces the normal response, the latter being analyzable into (1) the orientation, (2) the forward movement, and (3) the attack on the vibrating object. Mutilation experiments yielded evidence indicating the probability that the organs used in detecting the vibratory stimulus are sense hairs on the tarsi.

Regeneration.—Schmit-Jensen ('15, Smithsonian Report for 1914, pp. 523-536) made a study of homœotic regeneration of the antennæ in a phasmid, *Carausius morosus*. A "spontaneous case of substitutional homœosis" was noted among a lot of individuals (nymphs) which had suffered from cannibalism. An antenna, bitten off near the base, developed, after molting, a termination consisting of a distinct tarsus-like segment with a large empodium and two small claws. Subsequent molts witnessed the appearance of paired protuberances corresponding exactly to the paired plantulæ on the underside of normal tarsal regions. Amputation experiments on fifty specimens, involving removal of either or both antennæ at the level of the joint between the first and second, or the second and third antennal segments, resulted in the production of twenty cases of regeneration. These regenerations varied to some extent but all developed the tarsus-like terminations. Amputations made on young nymphs showed that regenerations developed more and more with each succeeding molt and the resemblance between the regenerated portion and the true tarsal region became greater. Under certain conditions of the experiments a tibia-like segment was also produced at the base of the tarsal region.

Orientation of Ephemera.—Krecker ('15, Biol. Bull., 29:381-388) finds that the positive reaction of May-flies to air currents

is evidently due to strains exerted on the muscles of those appendages which serve the function of attachment, rather than to sensations resulting from contact of moving air with the body. The normal resting position on vertical supports which is usually negative with respect to the earth's surface, is not, apparently, a pure reaction to gravity but is entirely or in part accounted for by the unstable character of the insect's attachment when in any other position. May-flies react negatively to bright sunlight but positively to certain artificial lights. An optimum zone surrounds colorless, sixteen candle-power, incandescent lights, beginning about six inches from each light and extending to about thirty inches, in which the positive reaction seems to be satisfied. Individuals alighting in this zone tend, if large numbers are present, to arrange themselves in rows corresponding to the radii. The area within six inches of the light is designated as the "excitement zone" since individuals entering this zone become excited and perform confused movements. The positive reaction is much stronger for slightly yellowish light than for red or blue. Red and blue lights produce the above-described alignment but a well-defined excitement zone is lacking.

Population of "Blanket-Algæ."—Platt ('15, Am. Nat., 49:752-762), in a study of the life of floating masses of filamentous algæ ("blanket-algæ") in fresh-water pools near Ithaca, N. Y., finds that insects are prominent components of such a community. The larvæ, nymphs, and adults of five orders of insects are regular inhabitants of the alga-masses and constitute the largest individuals of the population. Nymphs of Ephemerida (*Callibaetes*, *Baetis*, et al), nymphs of Odonata (*Enallagma*, *Ischnura*, et al), larvæ of Diptera (*Chironomus*, *Ceratopogon*, *Odontomyia*), larvæ of Coleoptera (*Hydroporus*, et al), and adult beetles (*Helophorus*, *Crenophilus*, et al) were found to constitute the principal insect population, the Diptera representing the greater part. *Chironomus* was one of the two animal forms which appeared most regularly. Members of this genus were present at all seasons. The larvæ of May-flies and midges are the principal plant consumers and since the

latter are so prolific they are of great importance as food for other animals. Important data concerning the plant and other animal members of this population are given.

Lepidopterous Larvæ.—Fracker ('15, Illinois Biological Monographs, 2:1-169), in an extensive paper on the classification of lepidopterous larvæ, reports, among others, the following general results: The primary setæ, which constitute important taxonomic characters, have an arrangement in all segments of the body of the larva which has been derived from the same ancestral type, the latter including twelve primary setæ which are arbitrarily designated by Greek letters. Modification of this type has come about in three different and independent ways, namely, tendency of prothorax to retain the maximum number of setæ, partial reduction on the meso- and metathorax, and reduction of abdominal chætotaxy without much change of positions. Other general conclusions of a more special nature are also given. Extensive keys to families, genera and species are presented, accompanied by detailed discussion. This paper covers the whole order Lepidoptera and is the most comprehensive and thoroughgoing treatment of the subject which has yet appeared.

Poisons of Plant-Lice.—Dewitz ('15, Ann. Ent. Soc. Am., 8:343-346) reports that the diluted extract of certain plant-lice obtained by triturating these animals in physiological salt solution or a mixture of glycerine and physiological salt solution, when submitted to ox blood, hæmolyzes the red blood-corpuscles even at ordinary temperatures. "1 gr. of plant-louse matter will completely dissolve the red blood-corpuscles of 25 ccm. of undiluted blood or 40 gr. will dissolve a litre of blood." The substance causing this hæmolysis is given the name *aphidolysin*. Nothing is known concerning the particular part of the body of the insect which contains this poison.

Stimuli and Egg Hatching.—Severin, Severin, and Hartung ('15, Psyche, 22:132-137) have carried on experiments to determine the stimuli which cause the eggs of *Chætogædia monticola*, a leaf-ovipositing tachinid (Diptera), to hatch. These eggs are deposited on various grasses and weeds and, at the time of oviposition, contain fully developed larvæ. Since the larva is a parasite in certain

other insects which consume the vegetation on which these eggs occur, what accounts for the sudden hatching in the digestive tract of the host which permits the parasite to begin penetrating the wall before being expelled with the excreta? Eggs, placed in the alkaline liquids exuded from the mouths of certain host caterpillars, began hatching within less than one minute, almost all of them hatching within three hours. Similar results were obtained using alkaline liquids from insects which are not the normal hosts. Hatching occurred, in most cases, in the mid-intestine. Emergence was partially prevented, sometimes completely so, in various acid media. Experiments seemed to show that increased turgidity causes the larvæ to emerge when the eggs were immersed in water or diluted alkaline solutions for thirty-six hours or longer. Evidence was secured which points to the probability that the digestive juices of the host, reaching the larva through the micropyle, stimulate it to perform the body movements and contractions by which the escape from the chorion is affected.

Polyembryonic Development.—Patterson ('15, Biol. Bull., 29:333-372) finds that in *Copidosoma gelechiæ*, a hymenopterous parasite of the *Solidago* gall-moth (*Gnorimoschema gallæsolidagonis*), polyembryonic development occurs, the egg giving rise, on the average, to about 191 individuals. The cleavage stages were not secured, the earliest development studied being that in which the division of the egg into embryonic primordia had begun. The young polygerms have an outer nucleated membrane and a central region containing the true embryonic nuclei. The latter, by segregation into groups surrounded by a dense layer of granular protoplasm, develop into the primordia of the multiple embryos. The polygerm elongates, breaks up into several spherical primary masses, each of which contains several primitive embryos. Primary masses give rise to secondary masses and the embryos separate from each other, each developing a covering composed in part of granular protoplasm and in part of protoplasm from the nucleated membrane. The intervening space becomes filled with an inter-embryonal substance, the subsequent dissociation of which liberates the larvæ, thus introducing them into the body-cavity of the host where they ultimately destroy the unchitinized parts of the caterpillar.

The emergence of males and females from the same caterpillar is interpreted as the result of the deposition of two or more eggs in the same host. However, the possibility "that such broods may also arise from a single fertilized egg by a process of disjunction of the sex chromosomes during the early cleavage stages" is suggested.

Gynandromorph Bees.—Morgan ('16, Am. Nat., 50:37-45), in a paper on the Eugster gynandromorph bees, reviews the evidence pertaining to the two chief theories as to the origin of these anomalous insects. Recent studies by Boveri and Mehling on the original Eugster gynandromorphs show that the male parts of these bees are *maternal* while the female parts are *paternal*, thus supporting the original hypothesis of Boveri that these anomalous insects are produced by a delayed fertilization or by some irregularity in the penetration of the sperm into the egg, resulting in the fusion of the sperm nucleus with one of the two nuclei produced by the division of the egg, with the ultimate production of an individual which possesses the characters of the male on one side and those of the female on the other. Morgan's theory of gynandromorph origin is based on the possible entrance of two or more spermatozoa into the egg with a subsequent union of one with the egg nucleus and the independent development of an outlying spermatozoan, the former producing female structures and the latter producing male structures. According to the theory of Boveri, the male parts resulting from the single egg nucleus should be *maternal* while by Morgan's theory the male parts derived from the single sperm nucleus should be *paternal*. Attention is called to the discovery by Newell that the drone bees inherit the characters of the mother. It thus appears that Boveri's theory holds, at least for the case of the honey-bee. Boveri's cytological argument in support of his theory is reviewed but it is found by Morgan to be of uncertain support. Mention is made of a third possible origin for gynandromorphs, namely, "dislocation during ontogeny of the two sex chromosomes." Gynandromorphs would be expected to arise in insects when conditions would prevail in which certain nuclei come to contain two sex chromosomes and others only one. Attention is also called to Goldschmidt's explanation of the gynan-

dromorphs which he secures in crosses of *Lymantria dispar* and *L. japonica*, an explanation which "involves the relative potencies of the sex factors in the different races."

Marine Insects.—Arndt ('15, Proc. Indiana Acad. Sci., 1914, pp. 323-336) presents a paper on the habits of the insects and spiders of the "between tides zone" at Cold Spring Harbor, Long Island. Particular attention is given to *Megamelus marginatus*, *Grammonata trivittata*, *Clubonia* sp., *Bembidium constructum*, *Heterocerus undatus*, *Bdelidæ* sp. (?), and *Lycosa communis*. The first three are characteristic of the *Spartina* grass area, while the last four are common in the outer *Juncus* area. Almost all insects inhabiting the zone between high and low tide present peculiar protective features, some of which are as follows: (1) Certain unique instincts serve to prevent them from being washed away by the tide, as for example, the tenacious clinging to the blades of grass by those insects which inhabit the *Spartina* zone, the habit of crawling under the gravel, and the wandering about for food only during sunny days at low tide. (2) The instinct of certain forms to swim to the *Fucus* thallus during the disturbance of high tide, an instinct which is interpreted as one resulting in protection from aquatic enemies. (3) Marked resistivity of tide zone species to drowning. (4) Structural modifications which facilitate locomotion, enabling the possessors to inhabit an environment in which safety may be dependent upon retreat. Attention is called to the necessity of tide zone insects being air breathers since the terrestrial conditions prevail for one-half of the time. During periods of high tide or submergence they are inactive. "The most striking phenomena is the strictly zonal distribution of the insects of the between tides zone."

Salts Required by Insects.—Loeb ('15, Journ. Biol. Chem., 23:431-434) has raised five generations of the banana fly, each of normal motility, on the following nutritive mixture: grape sugar, 0.5 gm.; cane sugar, 0.5 gm.; ammonium tartrate, 0.1 gm.; citric acid, 0.05 gm.; K_2HPO_4 , 0.005 gm.; $MgSO_4$, 0.005 gm.; H_2O , 3 cc. No $NaCl$ or $CaCl_2$, other than that which may appear as impurities in the chemicals used, was necessary. K and PO_4 appeared to be indispensable and SO_4 and Mg must be present. These ex-

periments show that as highly organized an animal as this fly can be reared on a culture medium as simple as that required for certain micro-organisms. Attention is called to the general assumption that the evolution of the higher animals could have occurred only after the appearance of green plants since the latter serve directly or indirectly as food for the former. Although this is true in general of the present fauna there is the possibility that "an evolution of animals as highly specialized as insects might have taken place independently of the existence of green plants." Attention is also called to the results of certain other experiments which indicate that the nitrite and nitrate bacteria are capable of forming carbohydrates from carbon dioxide, or possibly other atmospheric carbon compounds, independently of light, and other micro-organisms might have the same power. Such micro-organisms might furnish the carbohydrates necessary for development of other micro-organisms requiring sugars for their growth. It thus seems obvious that the evolution of animals as complex as the banana fly might have been possible without the existence of chlorophyll.

Inheritance of Pink Coloration.—Hancock ('16, Ent. News, 27:70-82) has made a study of inheritance of the coloration in the unusual pink form of the katy-did, *Amblycorypha oblongifolia*. He has found that this pink katy-did crosses freely with the normal green form. When a pink female was crossed with a normal green male, some of the hybrid F_1 progeny emerged from the egg after two years while the rest of the eggs hatched after a period of three years. Nine of the hybrids had pink coloration like the mother, and four were green like the male parent. The sexes were about evenly divided in both the pink and the green forms. These hybrid F_1 types have been inbred but the F_2 generation has not yet emerged. The pink and green color which appeared after the first molt was not materially affected by subsequent ecdyses. The pink and the green colors are hereditary and are regarded as germinal in origin. The theory that the color is the result of absorption of coloring matter accompanying the food is rejected.

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